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The Impact of Petroleum Consumption on Economic Growth in Zimbabwe (1980-2020)

By

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Abstract

This paper examined the impact of petroleum consumption on economic growth in Zimbabwe over the period 1980 to 2020. Time-series data were collected from the World Bank website, Reserve Bank of Zimbabwe's publications and Zimbabwe Statistics Agency (ZIMSTAT). To check the stationary of the series ADF and Phillips Perron (PP) unit root tests have been applied. The results of ADF tests revealed that all variables become stationary at first difference which confirms to co-integration test. Furthermore, Johansen Co-integration test has been used to examine the long-run relationship between the dependent and independent variables; therefore, the Johansen Co-integration test revealed that; there exists a long-run relationship among petroleum consumption and Gross Domestic product. The associated vector error correction model was estimated to obtain short-run elasticity's. The results showed that the coefficient of petroleum consumption is significant at all levels of significance, which indicates that there is a strong positive and significant long-run relationship between petroleum consumption and economic growth. This means that a 1% increase in petroleum consumption will enhance Gross Domestic Product by 0.64%. Therefore, the policy makers should prioritise building capacity additions and infrastructure development of the energy sector, as this will stimulate economic growth and increase energy supply in Zimbabwe.

1. Introduction

Energy, as a driving factor for development, is critical to the country's total economic growth, and its cost has a direct impact on the competitiveness of other services. Energy is required by all areas of the economy for output. Reproducibility is an important term in the economics of manufacturing operations. Some production inputs, such as energy, are not reproducible, but other variables of production, such as capital, labour, and natural resources, are long-term reproducible. Petroleum components (crude oil, gas pipelines, refined petroleum products, and other liquids) are one of the most expensive and scarce natural gifts, yet they are employed as a final consumer product as well as an energy source.

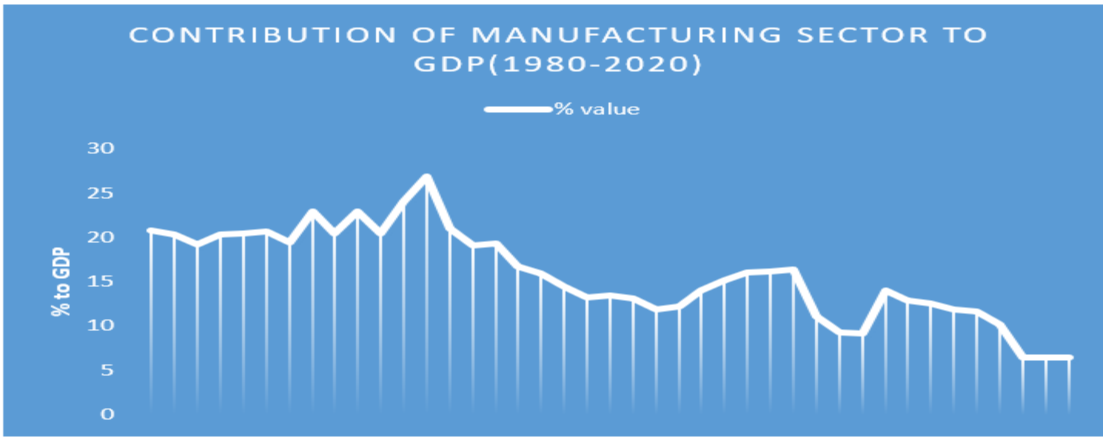
Diesel, gasoline (gasoline), kerosene (paraffin), jet fuel (jet fuel and piston engine fuel), and lubricating oil are the most common petroleum products in Zimbabwe. 3 million litres of diesel, 2 million litres of gasoline, 600,000 litres of jet fuel, and 200,000 litres of paraffin were consumed daily in 1998, when the country's economic output was at its peak. NOIC was in charge of procurement, transportation, storage, and handling, while Total, Shell, BP, Mobil, and Caltex were responsible for transportation, warehousing, and retailing. NOIC licensed six indigenous players, including Royal Oil, Country Petroleum, Wedzera Petroleum, Comoil, Exor Petroleum, and Engen, as these international firms began to encounter the issue of supplying adequate fuel to the market. Following deregulation, the government assumed regulatory responsibility and issued more licenses, resulting in a highly competitive market.

However, some of these entities have struggled to compete and have lost their way, while others have succeeded. The government planned to separate the state-owned oil business NOCZIM into the commercial company Petro Trade and the infrastructure company NOIC after scrapping the regulatory function. The oil industry's deregulation has resulted in a highly competitive market that has so far been able to secure a supply of petroleum products at regionally comparable rates. According to the Zimbabwe Regulatory Authority (ZIMRA), the country used 1.06 billion litres of fuel and 570.12 million gallons of gasoline in 2018. It amounted to $1.12 billion.

In 2015, the government passed SI 171, allowing the general public to import up to 2,000 gallons of petroleum gasoline per month for personal use. In 2017, (SI 171) was repealed and replaced with (SI 172). SI No. 122. This statutory document has freed all unauthorized fuel distributors. Participation is limited to companies that have been granted a license under Article 29 of the Petroleum Law. The Zimbabwe Energy Regulatory Authority now has permits for 73 oil trading companies (ZERA). Among the companies involved are Puma, Zuva, Total Zimbabwe, Engen, Trek, and Glow Petroleum. The Zimbabwean government began partially liberalizing the oil sector in 2001.This paved the way for mining, transportation, agriculture and other large commercial sectors to buy their own fuels in bulk.

Manufacturing Sector

Since 1980, Zimbabwe's manufacturing industry has had lower utilization rates and contributions to GDP. This is because the majority of Zimbabwean firms rely on finished product imports, local firms have become less competitive. As a result, unemployment has risen, exports have fallen, and the balance of payments has worsened. Manufacturing's contribution to Zimbabwe's GDP fell from 21.02 percent in 1993 to 9.17 percent in 2011, having previously risen from 20.38 percent in 1981 to 26.90 percent in 1992. (Fiscal Policy Review, 2009). Hyperinflation, currency controls, price controls, cash shortages, and power outages have all hampered facility utilization. Between 2011 and 2012, manufacturing's contribution to GDP increased to 14.04 percent. This is because of Zimbabwe's macroeconomic problems, manufacturing's current contribution to GDP has already fallen to 6.47 percent. Despite changes in the manufacturing industry from 1980 to 2020, it remains a significant participant in the country.



Agricultural Sector

The agricultural sector is the centre of Zimbabwe's economy for employment, income and poverty eradication. In 1985, the agricultural sector's contribution to gross domestic product (GDP) ranged from 6 to 24%. Overall, the contribution from 1985 to 1991 before the adoption of the Economic Structural Adjustment Program (ESAP) decreased from 20.7% to 6.8%. With the help of ZIMPREST, the contributions increased to 23.7% in 1999. When the country launched the Fast Track Agricultural Reform Program (FTLRP) from 2000 to 2004, agricultural contributions to GDP fell to 7.2%. The government has obtained financial assistance from the Zimbabwe Reserve Bank (RBZ) to finance agricultural sector through the Production Sector Facility (PSF 2004) and the Agricultural Sector Productivity Improvement Facility to restore agricultural contributions to GDP (ASPEF 2005). In 2008, it reaches the maximum of 24.2 percent.

This sector also declined between 2009 and 2013, with only a 1.1 percent increase in 2016. This sector now accounts for 15% to 18% of total GDP and 23% of all regular jobs. It employs approximately 70% of the rural population, accounts for approximately 63 percent of industrial raw materials, accounts for 60% of agricultural value added, and accounts for 30% of export revenue. Rather than an increase in agricultural production, the drop in agricultural GDP is primarily due to labour migration from agriculture to the informal services sector. This pattern demonstrates that Zimbabwe's agriculture sector is still failing to establish the necessary links to boost growth in other sectors and change the economy.

Despite an increase in petroleum consumption in Zimbabwe between 1980 and 2020, the manufacturing and agriculture sectors saw a decline in output and capacity utilization. The government embarked on various policy initiatives to address the situation, however, the manufacturing and agricultural sectors remain undercapitalized, with most farmers and businesses unable to secure the equity capital required for expansion of operation and modernization of their sectors. Whilst the banks remaining wary of lending to the sector. According to other experts, as the number of imported vehicles in Zimbabwe grows, so does the demand for petroleum fuel. Zimbabwe has also experienced sporadic power outages, forcing residents to rely on generators as a backup; as a result, non-productive petroleum consumption may have increased more than productive consumption. It is imperative for a researcher to examine the effect of petroleum consumption in Zimbabwe.

On the basis of the above problem, this study intends to provide answers to the following research questions, to what extent does petroleum consumption affect the performance of Gross Domestic Product in Zimbabwe? Is there a long-run relationship between petroleum consumption and economic growth? What scholarly and policy recommendation that can be established to the effect of petroleum consumption on economic growth? The main objective is to examine the effect of petroleum consumption in Zimbabwe, to determine whether there is a long-run relationship between petroleum consumption and economic growth, to proffer recommendations on how foreign currency could be better implemented towards the supply of petroleum fuel.

The purpose of this research is to answer the following research questions based on the aforementioned issue: to what extent does petroleum consumption affect the performance of Zimbabwe's Gross Domestic Product? Is there a long-run relationship between petroleum consumption and economic growth? What policy recommendations should be established on the impact of petroleum consumption on economic growth? The main goal is to investigate the impact of petroleum consumption in Zimbabwe, to determine whether there is a long-run relationship between petroleum consumption and economic growth, and to proffer recommendations on how petroleum consumption could be used more effectively in the country.

The remainder of this research study is structured as follows: The second section examined the literature on fuel consumption. The study continues in part three by presenting the analytical methodologies. The findings are presented and debated in the fourth section. The fifth section of the study summarizes, recommends, and draws an appropriate conclusion.

2. Literature review

The relationship between energy and economic growth has been a subject of empirical research since the energy crises of the 1970s (Hye & Riaz, 2008). The most frequently asked question was whether increased petroleum use is a cause or a result of economic growth. The majority of the empirical research discussed in this paper was conducted in an attempt to answer this question.

Behmiri and Pires Manso investigated whether crude oil consumption and Latin American economic growth are linked. The study examined whether there was a Granger causality relationship between crude oil consumption and economic growth from 1980 to 2012. They used a multivariate panel framework model with crude oil price as a control variable. According to the findings, economic growth and oil consumption do not Granger cause each other in South America and the Caribbean in the long run?

Bildirici and Bakirtas examined the causal relationship between coal, natural gas, and oil consumption and economic growth from 1980 to 2011 using the ARDL testing approach. The findings revealed a bidirectional causal relationship between oil energy consumption, natural gas energy consumption, and economic growth. Barbier investigated the role of natural resources in developing countries' economic growth. The findings revealed a positive relationship between economic growth and natural resource endowment. Furthermore, it was discovered that there is a long-run relationship among the variables based on data collected between 1980 and 2011.

Bildirici and Kay used the Panel ARDL technique to investigate the effects of oil production on economic growth in key oil exporting Eurasian countries from 1993 to 2010. The findings revealed co-integration and positive bidirectional causality between oil production and economic growth in these countries in both the long and short run. Bashiri Behmiri et al. (2009) used a panel multivariate approach to investigate the Granger causality between crude oil consumption and economic growth in 27 OECD countries from 1976 to 2009. Their findings revealed a bidirectional causality relationship between crude oil consumption and economic growth.

Ansgar et al. (2010) conducted a study on energy and its relationship to economic growth in Pakistan. He applied Hsiao's Granger causality and co-integration. The empirical data revealed that economic expansion has an impact on overall energy consumption, which contradicts previous research findings. According to the findings, there is no bidirectional relationship between economic growth and gas consumption. The study, on the other hand, discovered a two-way relationship between economic growth and energy consumption. According to the analysis, Pakistan's energy conservation policy would have no negative effects on the country's economic growth.

Furthermore, a study on the impact of energy consumption on economic growth in Greece discovered evidence of a level-dependent effect between the two variables, energy consumption and economic growth, using data from 1970 to 2010. (Eh, 2010.). According to the study, the relationship between energy consumption and economic growth in Taiwan is defined by an inverse U-shape. Other research supports the idea that energy consumption can help boost economic growth. The empirical findings, however, revealed that such a relationship existed primarily in Greece, where energy consumption was low.

Jamil et al. (2010) investigated the relationship between energy consumption and economic growth in Fiji using a multivariate framework. Using the bounds test co-integration approach, it was discovered that energy consumption, GDP, and labor were only co-integrated when GDP was endogenous. The study also used the Granger causality F-test, which discovered that in the long run, causality runs from energy consumption and labour to GDP, implying that Fiji is an energy-dependent country and that energy conservation policies have a negative impact on Fiji's economic output.

Akinlo (2008) investigated whether there is a causal relationship between energy use and economic growth in eleven Sub-Saharan African countries. Using the autoregressive distributed lag (ARDL) limits test, the researchers discovered co-integration between energy consumption and economic growth in Cameroon, Cote d'Ivoire, Gambia, Ghana, Sudan, Zimbabwe, and Senegal. According to this study, energy consumption appears to have a significant long-term beneficial impact on economic growth in Ghana, Kenya, Senegal, and Sudan. A Granger causality test based on the vector error correction model (VECM) revealed a bi-directional link between energy consumption and economic growth in Gambia, Senegal, and Ghana. However, Granger causality test showed that economic growth Granger causes energy consumption in Sudan and Zimbabwe.

Siddiqui et al. (2008), in particular, used a survey of four major industrial areas in Punjab—Gujrat, Faisalabad, and Gujranwala—to investigate the cost of lost energy due to Pakistan's power outages, which began in 2007. It was discovered that power outages increased the manufacturing costs of the companies. Energy shortages also slowed the delivery of supply orders. According to the survey, total industrial output losses ranged from 12% to 37%, with Punjab being the hardest hit. In addition to calculating output losses, the impact on employment, production costs, and supply order delays was calculated. The output loss was calculated using two-dimensional studies that accounted for variations in outage length and shift hours. The industrial sector's overall volume loss ranged from 269 to 819 billion rupees. In the overall analysis, the food and beverage, textile, and chemical product industries were the top three manufacturing subsectors in terms of losses.

Patrick and Dodzi (2014) conducted a study to determine the extent to which electricity consumption influenced Ghanaian economic growth and to determine whether electricity consumption was the cause of Ghanaian economic growth or not. The study employed the Augmented Dickey-Fuller test, the Co-integration test, the Vector Error Correction Model, and the Granger Causality test. According to the study, a 100% increase in electricity usage resulted in a 52% increase in real gross domestic product per capita over time. Electricity consumption, on the other hand, had a short-term negative impact on real GDP per capita. The analysis discovered that there was unidirectional causality between power consumption and economic growth, implying that any policy initiatives aimed at improving Ghana's smooth electricity consumption would have an impact on the country's GDP per capita.

Sun and Anwar (2015) used a tri-variate vector autoregressive framework that included entrepreneurship to investigate the relationship between energy usage and industrial production in Singapore's manufacturing sector. The study was carried out using monthly data from January 1983 to February 2014. There was evidence of co-integration among the variables, implying a long-term relationship between electricity consumption, manufactured output, and entrepreneurship in Singapore. It was also discovered that granger entrepreneurship increases electricity consumption, which increases industrial production. Sun and Anwar (2015) used the autoregressive distributed lag (ARLD) testing approach to confirm the results obtained from the Johansen co-integration approach.

Mpatane (2015) investigated the impact of energy supply on the South African manufacturing sector, and Johansen co-integration revealed two co-integrating variables. To determine whether the variables were stationary, the ADF, PP test, and KPSS were used. The VECM was calculated, and it was discovered that there is a positive long-run relationship between manufactured output and manufacturing employment, as well as manufactured output and electricity supply. The evidence for these findings is consistent with what was predicted in advance. According to the findings, both manufacturing employment and electricity supply play a role in bringing manufactured output into balance. In this study, the error term is stable, implying that the co-integration relationship is stable. The speed of adjustment is 13.5 percent. This is the rate at which manufacturing output returns to equilibrium following a shock in an independent variable such as power supply. This means that 13.5 percent of the difference between manufactured output and its equilibrium value is closed in the short run.

Many studies have been conducted to determine the factors that influence economic growth. However, the vast majority of these studies are carried out at the national and continental levels. The sectoral impact of petroleum fuel consumption has received little attention in Southern African countries, particularly Zimbabwe. As a result, this study is intended to add to the existing body of knowledge. Various studies have used field surveys to determine the relationship between economic growth and its factors. Adam (2012) conducted a study in which he used econometric analysis to investigate the impact of energy consumption on overall economic growth. Unlike previous studies that examined the impact of energy consumption on overall GDP per capita, this study will examine the long and short term dynamics of petroleum consumption on economic growth from 1980 to 2020, while accounting for structural changes with dummy variables. Enough econometric methodology will be used for time series data.

3. Theoretical Framework

The Cobb-Douglas production function serves as the theoretical foundation for the literature examined in this study. To depict the output-to-input relationship, the Cobb-Douglas functional form of the production function is commonly used. It was first proposed by Knut in 1926, and it was tested against statistical evidence by Charles Cobb and Paul Douglas in 1928. In 1928, Charles Cobb and Paul Douglas presented research that predicted the expansion of the American economy from 1899 to 1922. They saw the economy as having a basic picture in which the amount of labour involved and the amount of capital invested controlled production output. While many other factors are affecting economic performance, their model proved to be remarkably accurate. Their model of production was of the form:

$$Q = bL^{\alpha} K^{\beta} \text{…………………. (1)}$$

Where Q is total output L is the labour input K is the capital input b is the total factor productivity, α and β represent the output elasticity's of labour and capital, respectively. These values are constants determined by available technology. Output elasticity measures the responsiveness of output to a change in levels of either labour or capital utilized in production, ceteris paribus.

3.1 Empirical model

Yuzbashkandi (2020) of Switzerland conducted a literature review and estimated the Cobb Douglas production function to determine how changes in petroleum production may affect the economic growth of OPEC countries. The study believed that economic development is a function of petroleum production, the long-run equation is a double-natural logarithm.

GDP = f (PCONS, POPN, CF) ………. (2)

Where, GDP is the real gross domestic product and is measured in monetary value. PCONS is petroleum consumption it is calculated in terms of the sales value of petroleum consumed per annum, and CF is capital formation. It is calculated using annual time series data in constant US dollars. A manufacturing company's capital structure maximizes the market price of its shares by increasing ordinary shareholders' earnings per share. It is the specific mix of debt and equity that a company uses to fund its overall operations and growth.

Economic growth is expected to be boosted by population growth, petroleum consumption, and capital formation. The variables are transformed to logarithms except for petroleum use, which is already in percentages. This is done to obtain coefficient elasticity on the variables and to mitigate the effect of outliers. As a result, the model is shaped as follows:

$$ln_t = \alpha_0 + \beta_1 PCONS_t + \beta_2 lnPPN_t + \beta_3 CFt + \mu_t \,.. .\ (3)$$

3.2 Estimation procedure

Gujarati (2004) has it that, the error correcting mechanism (ECM) developed by Engle and Granger reconciles an economic variable's short-run behaviour with its long-run behaviour. If all of the variables in a set are I (1), there may be one or more equilibrium relationships that can be validated using the Johansen-Julius co-integration technique. If one or more co-integrating vectors are discovered for a set of variables, a VECM is a good estimation technique because it takes into account both short-run changes in variables and deviations from equilibrium. This model will be used to investigate the long and short run dynamics of petroleum consumption and GDP if the two variables are co-integrated; if they are not, unrestricted VAR will be used instead. In economics, error correction models are used to explain how the short run is corrected for the prior period's deviation from long run equilibrium.

To capture the dynamic relationship between the variables in question we adopt the Johansen co-integration test to establish any long run relationship between variables and VECM. The VECM directly estimates the speed at which a dependent variable returns to equilibrium after a change in other variables (Maddala, 2001). The method allows us to systematically incorporate the feedback effects from the long run model into short term dynamics analysis.

Econometric views (Eviews 7.0) software program was used to process and estimate all the collected data.

To estimate our model, equation (2) is then expressed as a dynamic autoregressive distributed lag model as follows;

$$\mathbf{X_t = \alpha + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \cdots + \beta_k X_{t-k} + \mu_t \ldots\ldots\ldots (4)}$$

Where: **X = [PCONS, ECONS, CF]**, such that if we compress equation (2) we get

$$\mathbf{X_t = \alpha + \sum_{j=1}^{k} X_{t-j} + \mu_t \ldots\ldots (5)}$$

We then transform the equation to be in a more parsimonious VECM form by subtracting X_t from both sides of the equal sign so as to obtain;

$$\Delta X_t = \alpha + \Pi X_{t-1} + \sum_{j=1}^{k} \Gamma \Delta X_{t-j} + \mu_t .. (6)$$

1. Where: **Δ** = the first difference operator

2. X_t = Kx1 dimensional vector of non-stationary I (1) endogenous variables of the model
3. α_0 = Kx1 dimensional vector of constant
4. **μ** = k-dimensional vector of the stochastic error term normally distributed with
5. white noise properties **N (0, σ²)**
6. **Π** = long run matrix that determine the number of co-integrating vectors that consists of α and β representing speed of adjustment towards long run equilibrium and long run parameter respectively
7. **Γ** = vector of parameters representing the short-term relationship

According to Lutkepohl (2013), co-integration, a characteristic of long run equilibrium, provides information about the variables' long run relationship, whereas the short run phenomenon provides information about the variables' short run dynamics.

3.3 Data analysis

3.3.1 Unit root test

The study used the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests to determine the presence of unit root that is, to ascertain if the variables are stationary. When dealing with a large and complex set of time series data with unknown orders, ADF was selected as the best method for testing for unit root because it is the simplest technique.

3.3.2 Johansen Co-integration Test

The Johansen methodology is one of the method used to estimate co-integrating relationship that may exist within a vector of non-stationary variables or a mixture of stationary and non-stationary variables. In contrast to single equation approaches, the Johansen technique allows for the possibility of many co-integrating vectors, which can aid in the reduction of simultaneous equation bias. There are two test statistics for co-integration under the Johansen technique, which are written as:

$$\gamma_{trace}\, r = -T \sum_{i=r+1}^{g} \ln(1-\gamma_i) \ldots . (8)$$

$$\gamma_{max} r(r+1) = -T\, \ln(1-\gamma_{r+1}) \ldots .. (9)$$

Where r is the number of co-integrating vectors under the null hypothesis and γ is the estimated value of the ith ordered eigenvalue from the Π matrix. Intuitively, the larger is the γ the larger and more negative will be in $(1-\gamma)$ and hence, the larger the test statistic. Each eigenvalue will have associated with it a different co-integrating vector which will be eigenvectors. A significantly non-zero eigenvalue indicates a significant co-integration vector.

Under the null hypothesis, r denotes the number of co-integrating vectors, and is the estimated value of the matrix's ith ordered eigenvalue from Π matrix. Intuitively, the larger the γ the larger and more negative (1- γ), and thus the larger the test statistic. Each eigenvalue will have its own co-integrating vector, denoted by the term eigenvector. An eigenvalue that is significantly non-zero indicates a significant co-integration vector.

4. Presentation and Discussion of Results
4.1 Unit Root Test

Table 4.1.1. *Augmented Dicker-fuller Unit Root Test Results at level*

Variables	ADF Test Statistic	McKinnon critical values			Decision
		1%	5%	10%	
LGDP	-2.049774	-3.689194	-2.971853	-2.625121	Non-stationery
LPOPN	-1.110270	-3.699871	-2.976263	-2.627420	Non-stationery
LCF	-2.103529	-3.615588	-2.941145	-2.609066	Non-stationery
LPCONS	-1.061793	-3.689194	-2.971853	-2.625121	Non-stationery

Source: Own estimation using Eviews version 7. *, **, and *** shows 10%, 5% and 1% level of significance respectively; the null hypothesis is that there is a unit root.

Stationarity is required for consistent and reliable inference of time series models and co-integration analysis. Table 4.1.1 displays the results of the Augmented Dickey-Fuller (ADF) unit root tests at various levels. The findings show that none of the table 4.1.1 variables are stationary. The ADF test statistic, which is smaller than the MacKinnon critical value even at 10%, demonstrates that H_0 is not rejected. As a result, the ADF test is going to be repeated at first difference to see if stationarity can be achieved for the variables in question.

Table 4.1.2. *Augmented Dicker-fuller Unit Root Test Results at first difference.*

Variables	ADF Test Statistic	McKinnon critical values			Decision	Order of integration
		1%	5%	10%		
LGDP***	-4.14106	-3.699871	-2.976263	-2.627420	Stationery	**I(1)**
LPOPN***	-4.043489	-3.689194	-2.971853	-2.625121	Stationery	**I(1)**
LCF***	-6.837003	-3.621023	-2.943427	-2.610263	Stationery	**I(1)**
LPCONS***	-3.725020	-3.689194	-2.971853	-2.625121	Stationery	**I(1)**

Source: Own estimation using Eviews version 7. *, **, and *** shows 10%, 5% and 1% level of significance respectively; the null hypothesis is that there is a unit root.

The results of the test have revealed that all variables are integrated of order I (1). We reject H_0 at 1% level meaning that the variables are stationary at first difference. Therefore, Johansen (1995) maximum likelihood approach will be applied to test the presence of co-integrating relationship among these variables.

4.2 Optimal Lag Order Selection Criteria

In determining the optimum number of lags, a maximum of 2 lags was initially set due to the number of observations (1980-2020). From the output obtained, the Akaike information criterion (AIC), Hannan-Quinn information criterion (HQ), FPE and LR selected lag order two, whilst the Schwarz information criterion (SC) selected lag order one. This study thus selected lag order two.

Table 4.2.1. *Optimal Lag Order Selection Criteria results*

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-36.83407	NA	1.37e-05	2.988148	3.226041	3.060874
1	56.6650	146.9271	1.06e-07	-1.904643	-0.477281*	-1.468284
3	94.27245	45.66619*	5.20e-08*	-2.805175*	-0.188345	-2.005184*

4.3 Co-integration Test

The trace and the maximum eigenvalue tests of Johansen-Juselius co-integration test was employed in-order to establish the existence of a long-run relationship between the variables since all the variables are integrated at 1(1). The null hypothesis of absence of co-integration is rejected at 5% significance level if the probability value does not exceed 5%. The co-integration test is reported in Table 4.1.4 and 4.1.5.The results indicate the presence of long-run relationship, that is, the variables are co-integrated. For instance, the Trace test and Maximum-Eigenvalue test both indicate the presence of two co-integration equation at 5%. Hence, the study concludes that using both tests, there is a presence of long-run relationship among the variables. Thus, the use of VECM approach becomes appropriate.

Table 4.3.1. *Unrestricted Johansen Co-integration Rank Test (Trace Results)*

No. of CE(s)	Eigenvalue	Trace Statistic	0.05 CV	Prob.**
None *	0.781220	95.50686	69.81889	0.0001***
At most 1 *	0.683884	52.95554	47.85613	0.0154**
At most 2 *	0.379208	20.70949	29.79707	0.3760
At most 3 *	0.192493	7.360248	15.49471	0.5361
At most 4*	0.047878	1.373737	3.841466	0.2412

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level *, **& *** denotes 10%, 5% and 1% level of significance respectively Source: Authors' Computation and EViews 7 Output.

Table 4.3.2. *Unrestricted Johansen Co-integration Rank Test (Max- Eigenvalue Results)*

No. of CE(s)	Eigenvalue	Eigen Statistic	Critical Value	Prob.**
None *	0.781220	42.55132	33.87687	0.0036
At most 1 *	0.683884	32.24605	27.58434	0.0117
At most 2	0.379208	13.34924	21.13162	0.4206
At most 3	0.192493	5.986511	14.26460	0.6149
At most 4	0.047878	1.373737	3.841466	0.2412

Source: Own estimation using Eviews version 7

4.4 Model Estimation

Results Table 4.10 displays the long run estimated results. The results showed that the coefficient of determination, R2 of 0.83532 (83%). It implies that 83% of the total variation in Gross Domestic Product (GDP) is explained by population growth rate (LPOPN), petroleum consumption (LPCONS) and capital formation (CF) with less than 17% accounted for by the stochastic error term (U) (that is, variables not included in the model). This implies that our regression captures more than 83% of total variation in petroleum consumption explained by the variations in the explanatory variables with less than 17% accounted for by the stochastic error term. The adjusted R^2 of 0.711665 (71%) suggested that the explanatory variable were robust in explaining the variation in Gross Domestic Product (GDP) and was of good fit.

4.5 Long run regression results

After taking into account the vector error correction, the model dictates that restrictions should be specified and a standard procedure for interpreting the long-run results be applied, such will be done in this research. Therefore, as per the vector error correction model decrees, a negative coefficient will be interpreted as being positive and vice versa.

Table 4.5.1. *Long-run estimated parameters.*

Variable	Coefficient	Standard error	t-statistics	Probability
c			6.660866	0.0000***
LPOPN	0.360313	0.10124	3.55893	0.00013***
LCF	0.17116	1.749757	10.2226	0.0000***
LPCONS	0.644866	0.05093	12.6624	0.0000***

*, **& *** denotes 10%, 5% and 1% level of significance respectively

R-squared 0.837769 Durbin-Watson statistic 2.050514
Adj. R-squared 0.718800 Probability (F-statistic) 0.000389
F-statistic 7.041904
Source: Author’s Computation, Eviews 7

The results suggest that capital formation (LCF), petroleum consumption (LPCONS), and population growth (LPOPN) have a positive impact on Gross Domestic Product (LGDP) and are all significant at 1% level.

Petroleum consumption has a positive impact on Economic growth suggesting that the more manufacturing sector, agriculture sector, mining sector among others consume petroleum fuels the more their output will increase. The results are consistent with theory and studies from Sama (2016) in Cameroon.

4.6 Error Correction Short Run Results

Table 4.6.1. *ECM Short-run estimated parameters*

Variable	Coefficient	Std. Error	T-Statistic	Prob.
ECT(-1)	-0.643172	0.15288	-4.20698	0.0000***
D(LGDP(-1))	0.53018	0.20072	2.64144	0.0185**
D(LGDP(-2))	0.001861	0.23552	0.00790	0.9938
D(POPN(-1))	-0.132344	0.37046	-0.3572	0.7259
D (POPN (-2))	-1.054003	0.33867	-3.11216	0.0071***
D(LCF (-1))	0.056826	0.064626	0.879308	0.3892
D(LCF(-2))	0.078120	0.060144	1.298880	0.2081
D(LPCONS(-1))	-0.263133	0.24842	-1.05921	0.3891
D(LPOPN(-2))	0.034551	0.06637	0.52061	0.6102
C	0.041615	0.02216	1.87825	0.0799*

*, **, and *** shows 10%, 5% and 1% level of significance, respectively.

R-squared	0.837769		
Adjusted R-squared	0.718800		
F-statistic	7.04190		
Probability (F-statistic)	0.000389	Durbin-Watson statistic	2.050514

Source: Own estimation using Eviews version 7.

The ECT (-1) is both negative and significant at 1%, suggesting backward movement of the model from a short run disequilibrium to a long run steady state at the speed of adjustment of 64%. This also confirms the presence of long run relationship among the variables. The result showed that the probability values of petroleum consumption for both first and second lagged period are insignificant. This, therefore, implies that petroleum consumption has not significantly resulted in increased Gross Domestic Product in the short run. This outcome lends credence to the works of Kakogawa and Shirota (2007). Gross Domestic Product is only affected by its first lagged period in the short run. This is evidenced by a positive and statistically significance at 5% level.

The result showed that petroleum consumption in the short run is insignificant for both first and second lagged period. This implies that fuel consumption has not significantly resulted in increased to gross domestic product in the short run. Therefore, the insignificant impact in the short run could be a result of several factors peculiar to the Zimbabwean context, which includes, most of the petroleum consumption is not channelled towards the productive sectors, there has been marked an increase in the importation of second hand vehicles in the country and the percentage consumes more fuel than it channelled to manufacturing, agriculture as well as mining sector. This outcome lends credence to the works of Cerdeira et al. (2012). Cerdeira et al. (2005) posited that the insignificant of petroleum in the short run may be as a result of some challenges affecting the effectiveness of channel of distribution, that is, in the rural areas petroleum consumption is very low and hence production is negatively affected. Eh (2010) posited that, due to an increase in the demand of automobiles, generators and other equipment or machineries that uses petroleum in Greece, petroleum consumption also increased. Some of the challenges includes a petroleum price increases.

However, the long-run coefficient results for petroleum is positive and statistically significant at 1% level of significance. This suggests that in the long run, petroleum consumption affect GDP positively. The elasticity coefficient of petroleum consumption is 0.644866% meaning that holding other variables constant, a 1% increase in the consumption of petroleum would induce a 0.64486% and should be consider in energy policy making. The results accept that, there is a positive long-run relationship between petroleum consumption and economic growth. This was also the conclusion given by Ezatolloh et al. (2010), where they found the relationship between energy consumption and economic growth in the Middle East to be positively and significant. Ahamad (2013) argued that energy works as an accelerator in the growth of production of goods and services in the economy hence it raises Gross Domestic Production.

The results exert that population growth rate has a positive (0.360313) coefficient which agrees with the a priori expectation. Precisely, a 1% increase in population growth rate, will lead to a 0.360313% increase in real GDP. This result is also statistically significant at 1% level of significance. Therefore, the null hypothesis was rejected and the alternative accepted. The results agree with that of Diskiene (2008), who found out population growth to be positively correlated with Gross Domestic Product in Nigeria. More so, data reviewed by World Bank has shown that a country with highest population has high Gross Domestic Product for example in Africa, Nigeria has a population of 211 million people and a Gross Domestic Product of $514.05 billion in contrast with Seychelles with a population of 98347 people and GDP of $950 000. However, countries with high population growth rate tend to have low GDP per capita.

Capital formation exerts a positive impact on manufacturing output in the long-run and is statistically significant at 1% as shown by a p-value which is less than 0.01. This implies that a 1% increase in capital formation increases Gross Domestic Product by 1.75% in the long-run and the impact is elastic. The results are similar to that of Akinlo (2008) where capital formation was found to be statistically significant at all level of significance. It has been revealed that, there is a positive correlation between energy consumption and economic growth. In this case any increase in capital is expected to enhance labour productivity and hence shifts the production function upwards. However, capital has no short run relationship with manufacturing output and this is also consistent with the neo-classical short run production function written as;

$$\boldsymbol{Y = Af(\bar{K}\,, L)}$$

Capital (K) is fixed in the short run and this implies that output (Y) increases through labour (L) productivity.

The results indicate that the constant term is 0.0283. This represents the average growth rate in Zimbabwe independent of the other variables. That is, the growth rate that occurs despite the above mentioned determinants of growth.

The findings research is similar to that of Ahamad et al. (2013) who carried out a study of investigating the relationship between energy consumption and economic growth in the Parkistan during the period of 1970 to 2013. Using the co-integration technique, the results have shown that, there exists a long-run positive relationship between current period energy consumption and economic growth. The study observes that, energy consumption is a strong determinant of economic growth. However, these results contradict similar studies of other researchers such as Kamogawa and Shirota (2007) who used carbon dioxide emissions so as to analyse the relationship between energy consumption, economic growth and carbon dioxide emission. The Ramsey-Cass-Koopmans model was employed and the results highlighted that economic growth and flow of pollutants are positively correlated. Hence in order to reduce carbon dioxide emissions, petroleum consumption has to be reduced Yu and Jin (1992) who concluded that energy conservation policies will not have a negative effect on economic growth.

5. Policy Suggestions and Conclusion

This study investigates the impact of petroleum consumption on economic growth in Zimbabwe using Vector Error Correction Model (VECM). According to the findings of this study, there is a positive and significant relationship between petroleum consumption and economic growth. Therefore, the study recommend that companies in charge of petroleum consumption procurement and transportation should increase petroleum supply across the country by connecting major cities with petroleum pipelines. Cleaner energy sources, on the other hand, should be used to reduce the effects of climate change caused by the use of fossil fuels.

Energy infrastructure should be maintained and improved. This includes not only appropriate maintenance practices for existing energy infrastructure, but also ensuring that such infrastructure grows by granting licenses to the private sector to operate such facilities and lowering legislative barriers to long-term capacity contracts. Natural gas infrastructure should be built and implemented throughout the country as well. The presence of such facilities will increase gas production, consumption, and possibly growth. To fully utilize various energy sources, the government should encourage energy research and development. To fully utilize various energy sources, the government should encourage energy research and development. More research and development is needed to stimulate innovation in the energy sector. Renewable energy research and development could be encouraged, which would boost

Finally, the government should increase the budgetary allocation for the sector and ensure that funds are released as soon as possible. The energy industry is undeniably capital-intensive and would necessitate substantial investments. According to the findings, energy consumption has a significant impact on Zimbabwe's economic growth.

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